Claims

1. A catheter comprising:

an elongated catheter body having proximal and distal ends;

an ultrasound transducer mounted at or near the distal end of the catheter body, the transducer having a front surface and an opposing back surface, wherein the transducer is positioned to transmit ultrasound energy toward tissue facing the front surface but not toward tissue facing the back surface;

a sensor mounted within the catheter near the ultrasound transducer for sensing a location and an orientation of the ultrasound transducer within a patient.

2. The catheter of claim 1, wherein the transducer is generally flat.

3. The catheter of claim 1, wherein the transducer is generally rectangular.

4. The catheter of claim 1, wherein the transducer has a length ranging from about 2 mm to about 10 mm.

5. The catheter of claim 1, wherein the transducer has a length ranging from about 5 mm to about 10 mm.

6. The catheter of claim 1, wherein the sensor is an electromagnetic location sensor.

7. The catheter of claim 1, wherein the sensor is mounted within 10 mm of the transducer.

8. The catheter of claim 1, wherein the sensor is mounted within 5 mm of the transducer.

9. The catheter of claim 1, wherein the sensor is mounted under the transducer.

10. The catheter of claim 1, further comprising a tip electrode on the distal end of the catheter body.

11. The catheter of claim 10, wherein the transducer is mounted on a surface of the tip electrode.

12. The catheter of claim 1, further comprising means for deflecting the distal end of the catheter.

13. The catheter of claim 12, wherein the means for deflecting the distal end of the catheter comprises:

a control handle mounted at the proximal end of the catheter body; and

a deflection wire extending through the catheter body, the deflection wire having a distal end fixedly attached near the catheter body's distal end and a proximal end anchored to a mechanism in the control handle that facilitates longitudinal movement of the deflection wire relative to the catheter body.

14. The catheter of claim 13, wherein the deflection wire is anchored at a position that is about 70° to 120° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally transverse to the direction that energy is emitted from the transducer.

15. The catheter of claim 13, wherein the deflection wire is anchored at a position that is about 90° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally perpendicular to the direction that energy is emitted from the transducer.

16. The catheter of claim 1, further comprising an irrigation passage extending through at least a portion of the catheter body and having an open distal end near the transducer to introduce fluid to contact tissue being ablated with the transducer.

17. A catheter comprising:

an elongated catheter body having proximal and distal ends;

a tip electrode mounted at the distal end of the catheter body, the tip electrode having an exposed electrode surface and a transducer mounting surface opposite the exposed electrode surface; and

an ultrasound transducer mounted on the transducer mounting surface of the tip electrode.

18. The catheter of claim 17, wherein the transducer has a front surface and an opposing back surface that faces the tip electrode, wherein the transducer is positioned to transmit ultrasound energy toward tissue facing the front surface but not toward tissue facing the back surface.

19. The catheter of claim 18, wherein the exposed surface of the tip electrode has a length ranging from about 2 mm to about 10 mm.

20. The catheter of claim 18, wherein the exposed surface of the tip electrode has a length ranging from about 6 mm to about 8 mm.

21. The catheter of claim 17, wherein the tip electrode has an exposed surface and a stem having a diameter less than the diameter of the exposed surface, wherein the transducer is mounted on a surface of the exposed surface.

22. The catheter of claim 17, further comprising a sensor mounted within the catheter body near the ultrasound transducer for sensing a location and an orientation of the ultrasound transducer within a patient.

23. The catheter of claim 22, wherein the sensor is an electromagnetic location sensor.

24. The catheter of claim 17, wherein the transducer is generally flat.

25. The catheter of claim 17, wherein the transducer is generally rectangular.

26. The catheter of claim 17, wherein the transducer has a length ranging from about 2 mm to about 10 mm.

27. The catheter of claim 17, wherein the transducer has a length ranging from about 5 mm to about 10 mm.

28. The catheter of claim 17, further comprising means for deflecting the distal end of the catheter.

29. The catheter of claim 28, wherein the means for deflecting the distal end of the catheter comprises:

a control handle mounted at the proximal end of the catheter body; and

a deflection wire extending through the catheter body, the deflection wire having a distal end fixedly attached near the catheter body's distal end and a proximal end anchored to a mechanism in the control handle that facilitates longitudinal movement of the deflection wire relative to the catheter body.

30. The catheter of claim 29, wherein the deflection wire is anchored at a position that is about 70° to 120° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally transverse to the direction that energy is emitted from the transducer.

31. The catheter of claim 29, wherein the deflection wire is anchored at a position that is about 90° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally perpendicular to the direction that energy is emitted from the transducer.

32. The catheter of claim 17, further comprising an irrigation passage extending through at least a portion of the catheter body and having an open distal end near the transducer to introduce fluid to contact tissue being ablated with the transducer.

33. The catheter of claim 32, wherein the irrigation passage extends through the tip electrode.

34. A catheter comprising:

an elongated catheter body having proximal and distal ends;

an ultrasound transducer mounted at or near the distal end of the catheter body, the transducer having a front surface and an opposing back surface, wherein the transducer is positioned to transmit ultrasound energy toward tissue facing the front surface but not toward tissue facing the back surface;

a control handle mounted at the proximal end of the catheter body; and

a deflection wire extending through the catheter body, the deflection wire having a distal end fixedly attached near the catheter body's distal end and a proximal end anchored to a mechanism in the control handle that facilitates longitudinal movement of the deflection wire relative to the catheter body, wherein the deflection wire is anchored at a position that is about 70° to 120° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally transverse to the direction that energy is emitted from the transducer.

35. The catheter of claim 34, wherein the deflection wire is anchored at a position that is about 90° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally perpendicular to the direction that energy is emitted from the transducer.

36. A method for epicardial ablation in a patient comprising:

introducing into the pericardium of a patient a distal end of a catheter comprising an elongated tubular body with a transducer mounted at or near the distal end of the tubular body, the transducer having a front surface and an opposing back surface, wherein the transducer is positioned to transmit

ultrasound energy toward tissue facing the front surface but not toward tissue facing the back surface;

positioning the transducer's front surface so that it generally faces tissue to be ablated; and

ablating the tissue to be ablated with ultrasound energy generated by the transducer.

37. The method of claim 36, further comprising determining the position and orientation of the transducer within the pericardium using a sensor mounted within the catheter near the ultrasound transducer.

38. The method of claim 36, further comprising deflecting the distal end of the catheter before or during the positioning of the transducer's front surface so that it generally faces tissue to be ablated.

39. The method of claim 38, wherein the distal end of the catheter is deflected in a direction generally transverse to the direction that energy is emitted from the transducer.

40. The method of claim 38, wherein the distal end of the catheter is deflected in a direction generally perpendicular to the direction that energy is emitted from the transducer.

41. The method of claim 38, wherein deflection is accomplished with:

a control handle mounted at the proximal end of the catheter body; and

a deflection wire extending through the catheter body, the deflection wire having a distal end fixedly attached near the catheter body's distal end and a proximal end anchored to a mechanism in the control handle that facilitates

longitudinal movement of the deflection wire relative to the catheter body, wherein the deflection wire is anchored at a position that is about 70° to 120° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally transverse to the direction that energy is emitted from the transducer.

42. The method of claim 41, wherein the deflection wire is anchored at a position that is about 90° relative to the direction that energy is emitted from the transducer to thereby deflect the distal end of the catheter in a direction generally perpendicular to the direction that energy is emitted from the transducer.

43. The method of claim 38, wherein the catheter further comprises a tip electrode.

44. The method of claim 43, further comprising ablating with the tip electrode before, after or during ablation with the transducer.

45. The method of claim 43, wherein the transducer is mounted on a side surface of the tip electrode.